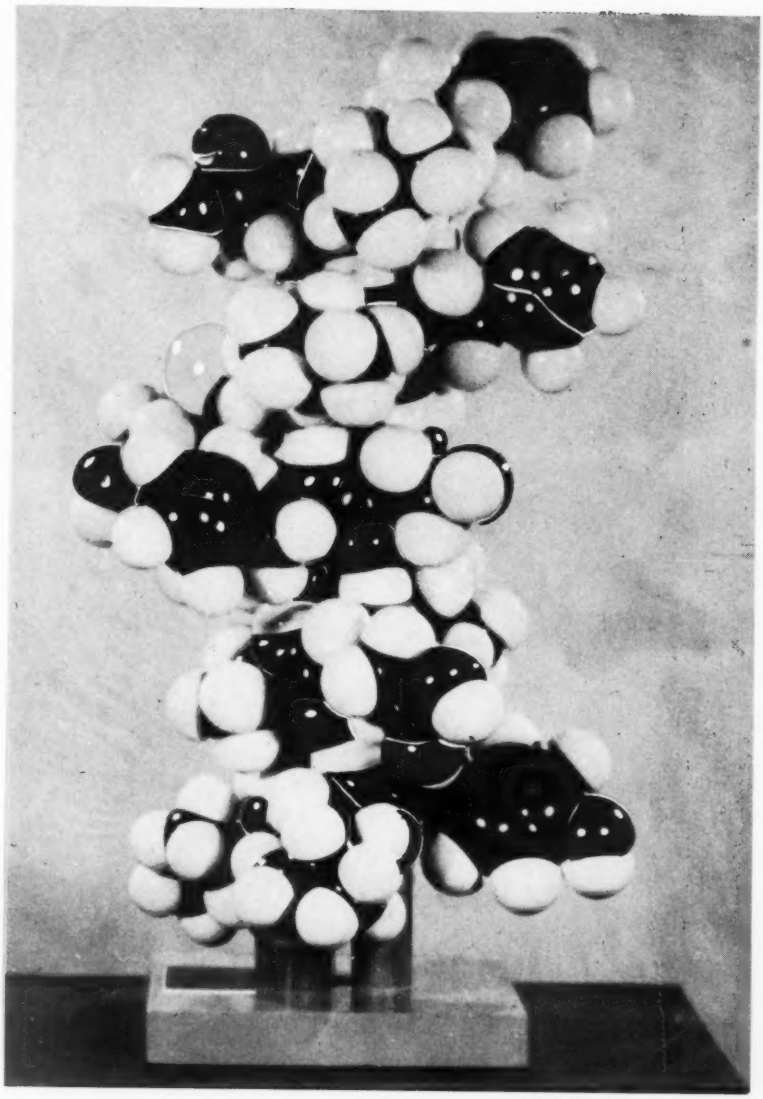
MAIN CURRENTS

IN MODERN THOUGHT



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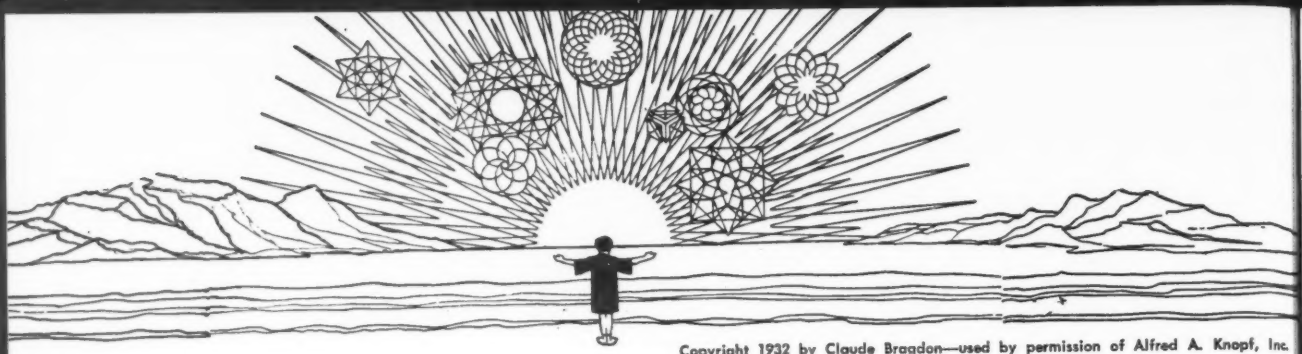

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MAIN CURRENTS
IN MODERN THOUGHT

A cooperative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.

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The illustration on the cover is of a conjectural model of the alpha helix, representing a part of the large and complex insulin molecule which was made by Professor Robert B. Corey of the California Institute of Technology, and kindly supplied by Professor Linus Pauling. A full description of the insulin molecule will be found on the colored insert immediately following Mr. Cochran's article.

EDITOR: F. L. KUNZ
ASSOCIATE EDITOR: E. B. SELLON
BUSINESS MANAGER: MARGARET WAGNER

PUBLISHER: JULIUS STULMAN

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THE QUANTUM PHYSICAL BASIS OF LIFE

Andrew A. Cochran

U. S. Bureau of Mines

A Proposal That There Is a Relationship Between Life and the Wave Aspect of Matter

IN the following paragraphs will be developed the idea that organization throughout nature has dual aspects. On the one side we observe particles, or things, or objects; on the other we assume, or demonstrate, the existence of waves.

Organization in its most intricate forms is evident in the higher animals and plants, and the term is virtually identical with the word life. And with life in these higher organisms we associate the capacity to experience and to accommodate to experience. It is common to say that a higher animal is conscious of the external world, and so long as this term is restricted—as it will be in this article—to mean experience in the foregoing sense, there is no reason why it should not be so employed. However, we do not here mean by the term consciousness the singular capacity displayed by man, who is able to examine his experience by means of some more deeply rooted resource, self-awareness, or awareness of one's self.

In the argument which follows, reasons are adduced to associate the livingness of things with their wave aspect, and in particular, with the wave aspect of the four substances universally occurring in living organisms.

THE currently held view is that atoms and the fundamental particles of matter are lifeless, and that life emerges as a property of the aggregate when atoms are properly combined. There is another possibility, however, which we should like to explore, namely, that the fundamental particles of matter possess a degree of life, and that living organisms are a direct continuance of this fundamental property of matter.

The idea that the fundamental particles of matter are lifeless is purely an assumption inherited from classical physics, an assumption which has never been justified or defended because it has never been challenged. Yet many theoretical and philosophical arguments lead to the belief that the fundamental particles have a feeble degree of life. Such modern developments as quantum theory and relativity give evidence in many ways that the laws of the universe are a result of the nature of the fundamental particles of matter, and that everything in it, including living organisms, results from various permutations and combinations of the properties of these particles.

In the present state of science, life is an unexplained singularity. Nevertheless, the fundamental particles possess properties very suggestive of life. Therefore, if a rudimentary degree of life is assigned to these particles, it explains not only their peculiar properties and behavior, but also how living things can be built from such particles. Such a theory would thus relate life to so-called inanimate matter.

In what way shall this degree of consciousness be assigned to matter? Since the fundamental particles exhibit wave-particle dual aspects which are entirely analogous to the mind-matter aspects of living organisms, we shall assume that what we call the wave nature of matter is actually the mind or conscious nature of matter.

Since it is difficult to convince scientists with such theoretical considerations, some evidence upon which to base these assumptions is needed. Our theory, to be valid, requires two things: First, that carbon, hydrogen, nitrogen and oxygen, which together constitute 99% by weight of living matter, have a high degree of "wave" nature at ordinary terrestial temperatures compared to the other chemical elements, and second, that carbon, *the* basic chemical element of life, should have a higher degree of wave nature than H, N and O, and very probably the highest degree of wave nature of all the chemical elements. If both of these statements are found to be true, our assumption that there is a relationship between life and the wave nature of matter will be supported by some evidence.

TWO closely related questions are of philosophical importance in trying to formulate a scientific explanation of life. The first is, are the processes of nature controlled in an absolute way by forces which are external to matter, or in a relative way by forces which arise from within matter?

The laws of classical physics were primarily a description of events in the order of magnitude revealed to us by our senses. When they were extended in an effort to explain atomic events, they broke down completely, and physicists were forced to seek more general and fundamental principles. The new quantum laws which resulted have been found to be more fundamental than the classical laws, since they include the latter as limiting cases and are therefore applicable to two different orders of magnitude.

Important conclusions can be drawn from this. The fact that the atomic laws are the more fundamental leads us to conclude that natural laws are due to the internal constitution of the basic particles of matter, and that the laws of large systems result naturally from these atomic laws. The concept that the processes of nature are controlled by external forces, on the other hand, involves the unwarranted assumption of the existence of an unknown, external causative agent. When faced with such a choice, scientists must select the simplest explanation which is consistent with all the known facts, for the very essence of science is to encompass ever wider ranges of phenomena with ever simpler conceptual schemes. Modern developments in quantum theory and relativity lead us to the tentative conclusion, therefore, that the laws of the universe result from the nature of its fundamental particles, and that everything in the universe results from various permutations and combinations of the properties of these particles.

The second question, which is closely related to the first, is whether the whole can be greater than the sum of its parts, as is widely held by modern thinkers.

Chief among the reasons for this belief is the idea that atoms and molecules are lifeless and are related to a living organism in the same way that nuts and bolts and gears are related to an automobile. Singly they are lifeless, but when put together properly the result is a man or an automobile, both of which are far more than just the sum of their parts. Another example used is that of an ordinary chemical reaction, such as $2H_2+O_2 \rightarrow 2H_2O$. In this reaction we find that the properties of the parts (hydrogen and oxygen) disappear, and new properties of the whole (water) appear.

These are some of the reasons advanced in support of the belief that the whole can be more than the sum of its parts. However, if all the properties of a physical system are a result of various permutations of the properties of the fundamental particles of matter, as we concluded above, how can these two positions be reconciled?

In considering the formation of water, we overlooked the fact that there are certain fundamental particles which are present in both the reactants and the product. The chemical reaction involves a rearrangement of the outermost shell of electrons of hydrogen and oxygen, and this rearrangement produces a new combination of the basic properties of protons, neutrons and electrons, which we call water. Certain chemical and physical properties have changed, but this is merely because the parts have been rearranged.

In the comparison between the automobile and man we also overlooked some important considerations. The automobile is primarily an intelligent arrangement of matter with the goal of producing motion in the desired direction. It does not possess any basic property not possessed by its parts, but instead is built to emphasize and make use of certain basic properties possessed by all matter, especially that of molecular motion. The auto is thus not more than the sum of its parts, but rather a combination of the sum of its parts, selected by man's intelligence for his convenience.

Is it also possible that man is not more than the sum of his parts? If so, this can only mean that we have not yet discovered all of the fundamental properties of matter, for in order to account for the existence of man and other living creatures it would be necessary to assign at least a feeble degree of life and intelligence to the fundamental particles of matter. Therefore we should consider the possibility that electrons, protons, photons, atoms, and so on have a degree of life, and that living creatures develop naturally from the matter of which they are constructed. In order to pursue this possibility, we must concentrate our attention on the microcosm in an effort to understand life.

Mind in Nature

IF we focus our attention on the elusive quantity we call mind, we find that there is no point at which we can say that the conscious life of the individual starts. Instead, there is a gradual sliding into conscious life, a gradual development of mind which parallels the development of body. Evidence from embryology shows that even before a brain develops the embryo's growth follows an intelligent plan: eyes are developed which will later see, lungs which will later breathe, and so on. The development of the embryo thus shows foresight, which is a characteristic of mind; it also traces the evolutionary history of its species, exhibiting memory, another characteristic of mind.

In like manner, when we consider the evolution of life forms down through the geological ages, there is no stage or level at which we can say that conscious life begins. The facts of organic evolution show us that all forms of life are closely related, and that the more complex developed from the simpler. In view of this, it is probable that the same association of life

and consciousness holds for all forms of life. Even the simplest protozoa exhibit rudimentary consciousness in their search for food and avoidance of danger, and an earthworm can learn to find its way through a simple maze.

From these considerations we conclude that life and consciousness do not occur separately in nature. This does not end our difficulties, however, for we must deal with the fact that there is no sharp dividing line between living and non-living matter; instead, there are gradations between. The viruses, bacteriophages and rickettsiae possess some, but not all, of the attributes of life. They are intermediate in complexity between the smallest living cells and the largest protein molecules. The viruses are parasites which can reproduce only by invading a living cell, and they can be made to crystallize like a simple salt. Instead of a dividing line between living and non-living systems, we again find an unbroken series of small gradations of complexity. Because of this, some thinkers have seriously considered the possibility that a very rudimentary consciousness resides in all matter. Wells and Johnson have both voiced this idea, and Baitsell came very close to it. In spite of centuries of searching, scientists have found no fundamental difference between living and non-living matter. Instead, the viewpoint of modern biologists is that the difference lies in the complex organization of living matter.

What is the essential difference between a living animal of known weight and an equal weight of the same chemical elements found in the animal? Obviously, the wonderfully intricate organization of the living animal. But to say this implies that the constituent atoms of which the creature is made have some of the qualities of life, for if matter becomes alive merely by the proper organization of its atoms, then these atoms must possess a degree of life which can be made additive or cumulative through proper combination.

THE thought which results from these considerations is that whereas in the past we have looked into such entities as cells, genes and chromosomes for the explanation of life, we must now look into even simpler aggregates, such as simple molecules and atoms, and even into the properties of the fundamental particles of matter. Probably the greatest achievement of biological science to date is the discovery that genes and chromosomes carry all the hereditary factors of living organisms. When we go even further into the microcosm, and search for relationships between the science of the microcosm (quantum physics) and life, we find that the precedent has already been set by a number of outstanding modern physicists. Bohr, Jordan, Schrödinger, Margenau and Bohm have all cast at least a brief glance in this direction.

Niels Bohr first pointed out that the dual aspects of the fundamental particles of matter are analogous to the dual aspects of man, and showed that the uncertainty relations apply to both. The fundamental particles exhibit dual aspects because they have the properties both of particles and of waves, while man exhibits dual aspects because he is both matter and mind. Pascual Jordan stated that living organisms must eventually be studied by means of the concepts of quantum physics, for the reason that their entire behavior is directed from amazingly tiny centers which belong to the atomic realm.

Quantum physicists claim that their science is capable of the eventual explanation of all the aggregates found in nature from fundamental principles, in other words, in terms of the laws governing the fundamental particles of matter. Since living organisms are one kind of atomic aggregate existing in nature, the explanation of life should exist somewhere in the framework of quantum physics. In his little book, *What is Life?*, Schrödinger states that in his opinion the "unknown" laws of life are merely the quantum laws. Mutations in living things are discontinuous changes caused by discontinuous quantum jumps in the gene molecule. He points out that a living organism is a chemical system with a high degree of order and organization, and therefore a low entropy. (Many biologists have further developed this idea of negative entropy in living systems.) Margenau states, "The advance in knowledge has also led physics to higher ground from which new and unexpected approaches to foreign territory can be seen. Not too far ahead lies the field of biology with its problems of organization and function, and one is almost tempted to say that modern physics may hold the key to their solution."

Returning to Bohr's thought that the dual aspects of man are analogous to the dual aspects of matter, is this analogy due to coincidence, or does it reflect a deeper physical relationship? If we suppose the latter, there is a possibility that the dual aspects of living creatures are a direct result of the dual aspects of the matter from which they are made. This would mean that what we call "wave" nature in matter is essentially the same as what we call "mind" in living things. It would also mean that in the experimental situations where wave explanations are important, the fundamental particles of matter could be described better in terms of mind.

TO attribute some of the qualities of mind to atoms or electrons will shock many modern scientists. Such concepts as choice, intelligence, memory and purpose are considered inadmissible to physical science. Yet it is precisely this restriction which has prevented us from relating life to the non-living, and thus limited the continued development of fundamental science. The concepts are considered inadmissible because one of the basic assumptions of classical mechanical science is that the fundamental particles of matter are lifeless. For half a century this kind

of science has been recognized as inadequate, yet its assumptions and its unconscious prejudices are still very much with us. As a result we have neglected the possibility that atoms, electrons, photons, etc., are not completely lifeless, and as a direct result of this neglect, we are still unable to include the phenomenon of life in our science. At the present time, life is a very important, yet unexplained, singularity in nature.

On the other hand, study of the fundamental particles of matter, begun and carried out under the assumption that they are lifeless, has yielded nothing but surprises. We have steadily and painfully learned that matter does not fit the category we had assigned it to. We have found that atoms possess motion, charge, field, and a stability which is impossible to explain with classical ideas. We have found that the fundamental particles of matter have an indeterminate nature which prevents the accurate prediction of their future courses and energies. In a given radioactive isotope a certain fraction of the atoms (which ones we cannot predict) will disintegrate in the next hour while the balance will not disintegrate, yet our theories tell us that all these atoms are identical.

We have discovered the strange properties of Helium II, a liquid whose great mobility prevents it from being held securely in any open vessel. We have become aware of superconductivity, a real perpetual motion of electrons involving no loss of energy. We have found that matter has motion and energy even at absolute zero, and that the complexity of matter demands increasingly complex explanations. We have found that part of the causality in nature resides *within* the particles of matter, instead of completely in external forces. We have found that determinism in nature is not absolute and machine-like, but instead is a partial determinism analogous to the familiar struggle of life against the forces of the environment. We have learned that living matter differs from non-living only in its complex organization. And finally, we have realized that the fundamental particles of matter exhibit dual aspects. These properties of matter, strange by classical standards, are consistent with the concept that all matter has a degree of consciousness.

IT might be helpful at this point to try to describe life in terms fundamental enough to be applicable to electrons and atoms as well as animals. What are the essential attributes of living matter? Even the most primitive creature finds suitable food, avoids pain or danger, regulates its metabolism, exhibits internal energy as distinct from the external forces in its environment, and displays choice in achieving its overall purpose of continuing to live and grow and reproduce itself.

For the sake of brevity we will characterize life as a system capable of exercising choice. It is understood that the choices do not require more expenditure of energy than is possessed by the system. In other words, the degree of choice is not absolute but finite, and can be overwhelmed by the opposition of larger forces. The choice of life then represents a tendency in a given direction, which may or may not be realized, depending on the strength of the opposing forces. (Note that this view of causality is entirely consistent with the present quantum mechanical view.) Non-life we will define as systems which are not organized so that the system as a whole exhibits any choice or purpose, as, for example, a stone.

We will further stipulate that the more choice a system possesses, the more it is alive. We suspect that the fundamental particles of matter possess a certain degree of choice, and that atoms, molecules, viruses, cells, and many-celled organisms have progressively more choice and life. A man has a very large number of choices open to him at any moment. We take the view that choice results from the presence of consciousness, and that consciousness itself is a fundamental property of matter which is not further analyzable, at least at present. Unfortunately it can only be defined in terms of another indefinable, namely, life.

The Wave Nature of Matter

SINCE we suspect that the wave nature of matter may be its conscious aspect, we are most interested in situations where it is revealed. Quantum physics gives us direction in this matter: whenever we measure the *position* of a particle, its particle nature is clearly revealed at the expense of its wave nature, and the latter becomes vague and poorly defined as a result of the measurement. On the other hand, whenever we measure the *momentum* of a particle, its wave nature becomes clearly defined and its particle nature becomes poorly defined. The kind of apparatus with which an electron interacts determines which of these potential aspects—wave or particle—prevails.

What is the fundamental difference between the two types of interaction? The position of a particle is usually measured by having it interact with, and scatter, either lighter particles or photons. In this type of measurement there must be an interaction between the two particles in which there is at least one quantum exchanged. The exchange of the quantum thus changes the energy and momentum of the two interacting particles. The momentum of a particle may be measured by finding the potential drop necessary to bring the particle to rest. In this type of interaction the total energy of the particle does not change. In coming to rest in the imposed field, the particle loses kinetic energy but gains an equal amount of potential energy with respect to the field. Momentum may also be measured by allowing the particle to undergo diffraction and measuring the angle. In this case the diffraction itself does not change the momentum or energy of the particle.

Apparently the fundamental difference between the two types of interaction is that in one case the total energy of the particle does not change, while in the other case it does. In order to study the wave nature of matter, we are therefore primarily interested in interactions in which the total energy of a particle remains constant.

WE suspect that atoms, electrons, photons, etc. have a degree of consciousness, and that living organisms are the result of the intelligent organization of such conscious particles. Since the elements carbon, hydrogen, nitrogen and oxygen are by far the most plentiful elements found in living matter, we might also suspect that their degree of consciousness is particularly high compared to the other chemical elements.

Of these four elements we can single out carbon as the one which is uniquely suitable as a basis for living matter, for no other element approaches carbon in the ability to form molecules in which a large number of like atoms are joined together. The number of combinations possible with carbon and hydrogen alone is great, and this number is enormously increased by the presence of other elements, especially oxygen and nitrogen. As a result, carbon forms more compounds than all the other elements put together. It is obvious that the complexity of living matter depends to a great extent on the ability of carbon to form long chains and rings. Because of these unique properties, carbon may be regarded as *the* basic chemical element of living matter.

We must also note that carbon certainly does not occur in living matter because of its abundance on earth, since it constitutes less than 0.03% of the earth's crust. Carbon must therefore occur in living matter because of some special properties it possesses, and perhaps these properties involve something more fundamental than the ability to form long chains, rings, and compounds with many other elements. Our line of thought indicates that the special characteristic which makes carbon the basic element of living organisms is its high degree of consciousness compared to other chemical elements.

We have postulated that the wave nature of matter is its conscious nature. This postulate can be tested by using it to make predictions which, if verified, then constitute evidence to support the theory.

TWO predictions which arise from our postulate are, first, that the four chemical elements, H, N, O and C have a high degree of wave nature compared to the other elements; and second, that since carbon is generally considered to be *the* basic chemical element of life, it has a higher degree of wave nature than H, N and O, and therefore probably the highest degree of all the chemical elements at room temperature.

If these two predictions are accurate, it will constitute evidence of a relationship between life and the wave nature of matter. Fortunately, they can be tested on the basis of the heat capacities of the solid chemical elements at ordinary temperatures.

Carbon, in either diamond, graphite or amorphous form, has a low heat capacity compared to other solid elements. At ordinary terrestial temperatures most of the carbon atoms are in their lowest quantum state (the state they occupy at absolute zero), and are not participating in energy exchange.

An atom in a crystal will in general possess both a degree of particle nature and of wave nature. This atom is exchanging heat energy with its surroundings, which reveals its particle nature, since quanta are being emitted and absorbed. The same atom is oscillating about its lattice position of minimum energy. This oscillation is a field interaction in which the total energy of the atom remains constant, even though kinetic energy and potential energy are being continually interchanged. Since the total energy of the atom is conserved, this oscillation is the type of interaction which reveals wave nature. A given atom will then tend to exhibit wave aspects except when interrupted by the absorption or emission of a quantum of energy, which reveals its particle aspects at the expense of its wave aspects.

If a crystal is heated to a high temperature its particle nature will predominate, since practically all of its atoms are exchanging quanta. If it is cooled to absolute zero its wave nature will predominate, since none of its atoms are exchanging quanta with the surroundings. Substances of low heat capacity have a large fraction of atoms whose wave aspects are predominate. Therefore substances of low heat capacity have a high degree of wave nature. On the other hand, when the heat capacity is high, the substance has a high degree of particle nature.

Since the different solid chemical elements at room temperature have different rates of energy exchange with their surroundings, we can tabulate the elements with the highest degree of wave nature on the basis of their heat capacities. The following series is arranged with the elements having the highest degree of wave nature (lowest heat capacity) in decreasing order from left to right:

Element:	C,	H,	B,	Be,	N,	Si,	O, . . .
*Heat Capacity**:	1.8	2.3	2.7	3.2	3.4	3.8	4.0

We thus see that the four basic elements of life rank first, second, fifth and seventh out of the ninety-two natural elements, with carbon possessing the highest degree of wave nature, as was predicted.

Since both of our predictions are found to be true, we conclude either that this is due to chance (which is improbable, since the odds are 1 out of 2,235,400 combinations), or else that there is a relationship between life and the wave nature of matter.

*Approximate atomic heat capacity in solid compounds at 0^0C, from Kopp's Law.

FROM our study of the second law of thermodynamics and the concept of entropy, we are all quite familiar with the tendency toward disorder which exists in matter. The opposing tendency, toward order, has not been emphasized nearly so much, yet it is illustrated by the formation of pure crystals from less orderly liquids or gases, by the orderly state and stability of the atom as well as the solar system, by chemical combination, and by the existence of living organisms. Living matter is highly organized, and the orderly tendencies of matter are quite apparent in the growth and development of an individual, or in the evolutionary development of complex forms of life from simpler forms.

Therefore we must take the view that matter has two opposing tendencies, one toward order and the other toward disorder. Generally speaking, at high temperatures the bombardment of photons of radiation overcomes the orderly tendencies of matter and disrupts the aggregations which are stable at lower temperatures; while at low temperatures, where the photon bombardment is greatly reduced, the orderly tendencies of matter win out. However, the real criterion is not temperature, but quantum state. When a substance is in its lowest quantum state its orderly tendencies are fully realized. The lowest quantum state of most substances is reached only at temperatures near absolute zero, but some substances, such as diamond, graphite, and living matter have a large fraction of atoms which are in their lowest quantum state even at room temperature.

Our theory leads us to postulate that the orderly tendencies of matter are a result of the degree of consciousness possessed by each atom. If left alone, these atoms will, by exercising "intelligent" choices, form orderly arrangements of gradually increasing complexity. The degree of choice possessed by carbon (and to a lesser degree by H, N, and O) enables it to form and maintain chemical bonds strong enough to survive against the surrounding thermal disorder, and to take advantage of chance opportunities to attain greater complexity by forming long chains and rings with other carbon atoms, and compounds with other elements. The increasing complexity and order of these molecules enable them to have an increasingly high degree of choice, in other words, to be more alive. The continuation of this process is the attainment of the degree of complexity and choice which we call living organisms.

In a living organism, the atoms are in a very complex and orderly arrangement. The survival of even the simplest organism depends on the performance of a multitude of intelligent actions: digestion and assimilation of food, discard of waste, reproduction, and so on. The process of regeneration, whereby cells and tissues are healed and repaired when injured, is carried on locally, using material from the blood stream. Processes like digestion, respiration and blood circulation are subject to a certain degree of control by primitive centers of the brain, but they are also controlled to a degree by the matter in the organs and tissues involved. The success and flexibility of the arrangement is due to on-the-spot intelligence at each point of the process, which implies a degree of intelligence in the fundamental particles of matter, in the aggregates of particles that we call atoms, and in the more complex aggregates called cells.

Thus, the fact that the chemical elements basic to life have a high degree of wave nature compared with the other chemical elements indicates a relationship between life and quantum physics.

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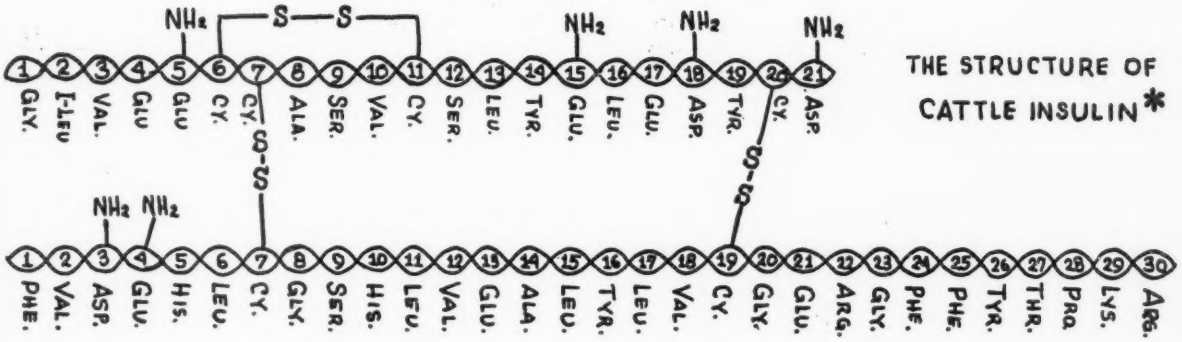
The Insulin Molecule



NOBEL-PRIZE winner Linus Pauling calls the structure depicted on our cover a "stochastic" model of a part of the insulin molecule. According to Pauling, a "stochastic hypothesis" differs from the other kind in that it professes to be composed entirely of verifiable facts and is subjected to verification as quickly as possible . . . The principles used in formulating a stochastic hypothesis must be restrictive enough to make the hypothesis itself essentially unique; in other words, an investigator who makes use of this method should be allowed one guess . . . (1). Dr. Pauling describes the cover illustration as follows: "A model of the alpha helix, with side chains as they are ordered in the insulin molecule. The alpha helix is the principal way in which the polypeptide chains of proteins are folded. This model is not supposed to represent precisely the structure of insulin, because as yet the precise structure has not been determined; but I think that it can be considered to represent one part of the insulin molecule in a rough way."

The brilliant elucidation of the complete covalent structure of insulin by Sanger and his colleagues (2, 3, 4, 5) has opened up a vast and fascinating area of research, involving the direct comparison of physical and functional data with known molecular structures (6).

The insulin molecule has an empirical formula of $C_{254}H_{377}O_{75}N_{65}S_6$, (7) and—for its monomeric form —a molecular weight given as 5734 by Ryle et al. (5) (This paper (5,) as well as (6) and (9), also contains the detailed formula in the figure above). The molecule consists of two chains of amino acids, the A (or glycyl) chain and the B (or phenylalanyl) chain which are linked in two places by disulfide bonds. In addition to these inter-chain disulfide "bridges" the glycyl chain contains an intra-chain disulfide bridge linking the amino acids at positions 6 and 11 of the glycyl chain.

The amino acids encompassed by this bridge, particularly those at positions 8, 9 and 10 of the glycyl chain, have a greater-than-ordinary significance both from the point of view of protein structure and that of evolution. This was seen by Linderstrom-Lang (8) in the context of a proposed insulin model based on Pauling's alpha-helix (1) in which he suggested that insulin could be represented by a right-handed helix for the B chain and a left-handed one for the A chain. The amino acids at positions 8, 9 and 10 of the A (glycyl) chain could not be accommodated into an undistorted alpha-helical structure, and it was therefore suggested that this part of the glycyl chain forms a "loop" outside the main glycyl chain helix.

This suggestion of loop formation was recalled recently when Harris et al. (9) found the molecular structures of insulin from cattle, pig, sheep, horse and whale to be identical except in respect to amino acid residues located within this "loop," or intra-chain disulfide bridge. The fact that all the species differences in insulin appear to be confined to the loop is tentatively explained by these authors on the basis of Linderstrom-Lang's suggestion (8) that the "loop amino acids" would have greater mobility and accessibility than the other amino acids which are stabilized

*Abbreviations used for the amino acids: Ala: Alanine, Arg: Arginine, Asp: Aspartic Acid, Cy: Cystine, Glu: Glutamic Acid, Gly; Glycine, His: Histidine, I-Leu: Iso-Leucine, Lys: Lysine, Leu: Leucine, Phe: Phenylalanine, Pro: Proline, Ser: Serine, Thr: Threonine, Tyr: Tyrosine, and Val: Valine.

between the inter-chain S-S (disulfide) bridges.

The structural localization of species specificity found by Harris et al., implied that during evolutionary development successful imitations have occurred only in those genes which control the structure of these three sites (positions 8, 9 and 10 of the glycyl chain). The above discussed structural considerations suggested further that the additional "degree of freedom" (i.e., the greater mobility and accessibility) of the "loop amino acids" may be in some way reflected in the genetic factors which control the synthesis of this part of the molecule.

Here we are witnessing one of the first instances in which genetic theory (the theory of heredity) is aided in the development of evolutionary concepts by the protein chemists' findings regarding the architecture of his macromolecules.

—G.J.M.

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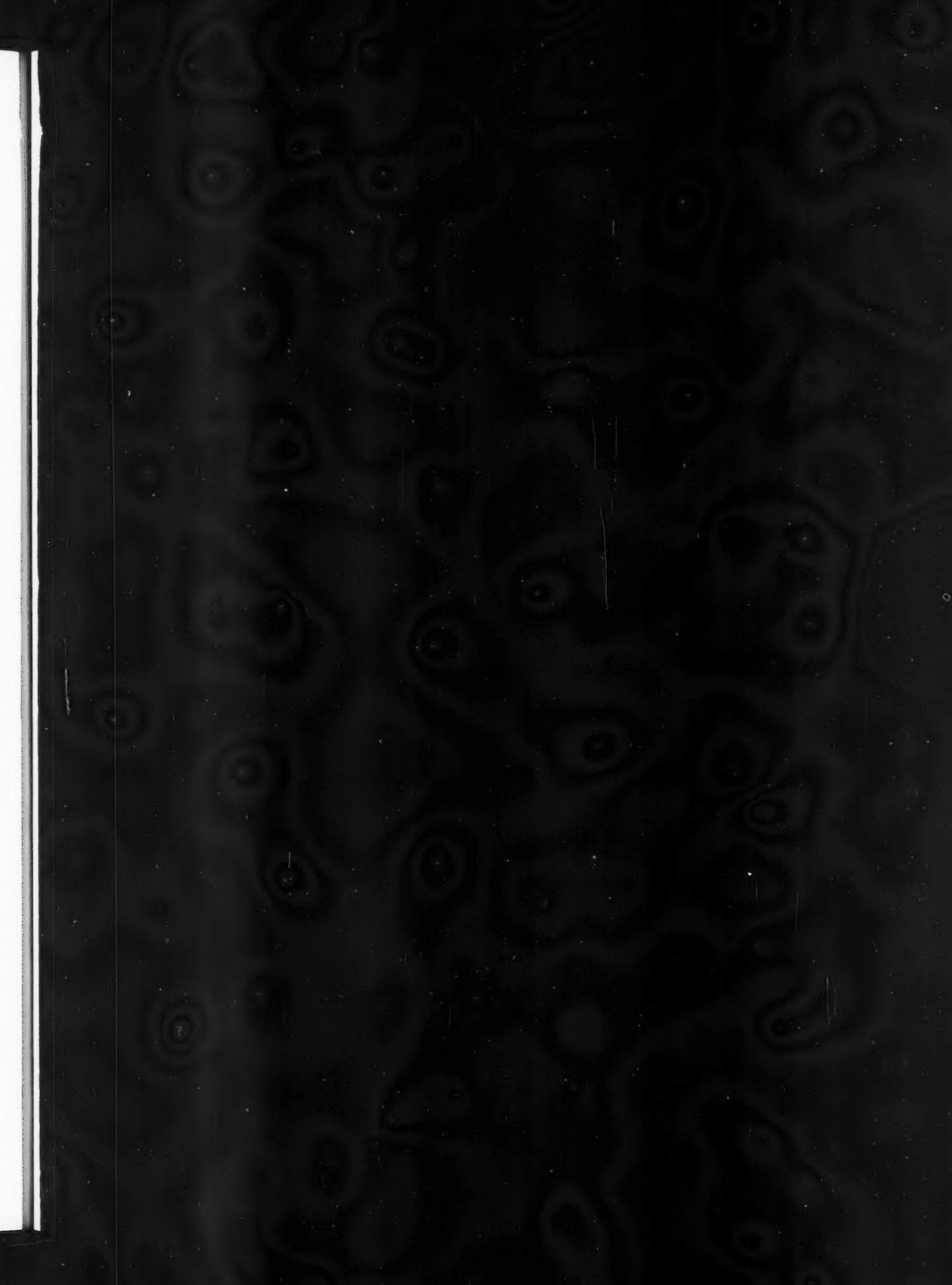

THE IMPORTANCE OF INDIVIDUALITY*

Robert J. Blakely

The Fund for Adult Education

The Need for an Educative Society Which Can Foster Enlightened Individualism

EVERY second one thousand babies are born in the world, sixty of them in the United States. Let us think about one of these babies.

In nine months, an amoeba, a fish, a tadpole, a monkey, has become a human being. An internal parasite has become an external parasite. An "it" has been nakedly revealed to be a "him" or a "her." Nature's duties have been taken over by nurture, whose first acts are benevolently disrespectful: to hold the baby by the heels with one hand and hit him on the bottom with the other. The baby performs his first autonomous act: he draws his original breath and, in rage, he cries for help. The individual and society have met. Education has begun.

Twenty-one years from now, more or less, this character will be ready to turn again the cycle of generation. He will be regarded by a college as an alumnus, by a state as an adult, by the federal government as a social security number. How will he regard himself? And how will his self-regard be thought of by the American society of 1978?

What can one say about this brief period? At least that it will probably be the most eventful twenty-one years in history, because of the scope within which things are happening and the factors which are accelerating change. Twenty-one years from now, human beings may be on the moon; they also may not be on earth any longer. Man may have learned how to control weather, or he may have changed it very much for the worse. It is also possible that man may have altered the genetic inheritance of the race, a power denied him in the past.

In the next quarter century, man will experience the full implications of one of his new inventions: alloplastic evolution, or evolution by tools. Man uses tools to do things which other forms of life can only accomplish through organic change. He can put on tools as wings and fly like a bird; with other tools he can swim like a fish. He can put away both these tools when he wants to, and this is very important, for by so doing he can return to his position of generalist—he whose specialty is generalization. For although most people in the future will need to be specialists in one or more ways, yet at the same time they will need to be able to relate their specialty to the whole fabric of society. This problem, which has been created by the new world of applied science, raises an important question: Who is to create integration from the specialized fragments of society?

Two fairly logical solutions to this problem have been worked out. The first is totalitarian: that system in which the integrating is done by the few—ultimately, by one person. When Khrushchev spoke about the "cult of the individual," he meant the cult of one person, the man-God, like Stalin and Hitler, who arbitrates all questions and makes all decisions. But in a democratic system, in which the aim is self-government, the solution is other, for the integration must be done by the self-governing individuals who form society.

CONSIDERATION of the relationship between the individual and society may begin by observation of a simple living organism, and its physical environment. If the organism has no control over its environment, it must seek its security by adaptation; when it gains some control over its surroundings, to that degree it can adapt its environment to itself. Human culture and society are inventions designed to make it possible for human beings to stabilize and direct their environment. In this situation, the behavior of people becomes of crucial importance. Society is in one sense an abstraction, but in another sense it is a real and necessary condition for individual freedom: a pattern of values and behavior which individuals create and experience.

Since society is the environment of the individual, and the individual is part of the environment of all other individuals, the question is, how do these indi-

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viduals regard each other? If they see one another as parts of the physical environment it is only logical and appropriate that they should try to manipulate each other, regarding every man as a natural antagonist, part of the not-self. On the other hand, if men regard one another as fellow human beings sharing in a common enterprise, they respect the individuality and responsibility of each.

It seems to me that we are in a period in which the individual is regarded more and more as furniture of the environment, with a consequent intensification of the attempts to manipulate him. It is ironic that just when we have achieved our greatest degree of control over our physical environment we should try to mold the individual to the environment (which includes society) rather than the reverse. If my judgment is correct, we are in a period of reaction against individualism, which is defined as selfishness. In this identification individuality is blighted. We are in a period of reaction against freedom, which is identified with irresponsibility. The consequence is standardization. We stress socialization, and achieve facelessness; we stress equality, and get mediocrity—or worse.

One reason for this lies in the historic conflict between liberalism and democracy. This conflict is not mentioned much any more, but one hundred years ago such people as de Tocqueville, Lord Acton and John Stuart Mill wrote about it a great deal. In the very first paragraph of Mill's essay *On Liberty,* he says that the worst form of tyranny in the future will be created by the majority. This kind of social tyranny is most dangerous because it is hardest to resist. It takes great strength of mind to rebel against the pervasive tendency to be the same as everyone else.

The root idea of liberalism is freedom; the root idea of democracy is equality. In the past, freedom was identified with privilege, and in the revolt against privilege, excellence and originality have been casualties. In the same way, inequality was identified with injustice, and in the struggle for justice, variety has suffered.

In America, we have given self-government to almost all adults, but we have not educated them for the rights and freedoms they have achieved. We have not learned how to stimulate people to take advantage of the opportunities with which they are provided. Liberalism has always assumed a necessary connection between freedom and education: either, as in an aristocracy, that only free men could be educated, or, as in a democracy, that only educated men could be free. The first idea we have rejected; the second we have forgotten or never learned.

To say that the drive of liberalism toward freedom and democracy toward equality are in conflict does not mean one must choose between the two. Conflicting drives give stress to life, and, as John Walker Powell has observed, ". . . the resistance to stress is what creates structure." Neither goal is a simple one. Freedom has its conflicting varieties, all of which involve the question of responsibility. On the other hand, does equality mean equality of condition or of opportunity? In what ways are men equal, if they are equal? How can we benefit from our inequalities in measurable ways and share our equalities in immeasurable ways? Here in the United States we uncritically identify equality with sameness, and both freedom and democracy suffer because of our confusion.

A number of special factors contribute to the current trend against individuality. One is the inadequacy of our conception of the sovereign national state. The word "sovereign" justly describes the situation, for the state is sovereign over humanity. In preserving the fiction of the freedom of the sovereign, independent national state, we are paying the price in terms of freedom for the reality, which is the individual. This issue is avoided today, but it will soon have to be faced. I have a conviction that the solution may lie in the idea of federalism, which is based squarely upon the conception that the individual is the reality, that human beings have certain inalienable rights, that governments are instituted to serve these rights, and that they can be created or altered or abolished accordingly.

Another special factor of our times is man's increasing interdependence. This leads us to think of other people in terms of functions rather than of individuality: "What can this person do (usually, for me)?" rather than "What is this person like in himself?" This situation is fraught with an insidious danger, for in it is involved the kind of benevolence, or rather, sentimentality, which wants people to be happy. On a low level, happiness means that they should belong—a double-edged word which can also mean that they should be owned—and that they should be "adjusted."

Yet another factor leading toward this standardization is, I think, the increasing pervasiveness of mass media of communication, which includes mass education. The very essence of a mass medium is that millions of people are reached by one expression or one idea, reiterated again and again. This cannot be done without depriving many voices of a chance to be heard. Education must be for the many; ideally, for all. But in itself education is always an individual thing, and students cannot be individually liberated through standardization. If this is a harsh judgment, I would defend it by asking how many adults today conduct systematic efforts to continue their exploration of the meaning of life and of themselves?

A fourth factor has been called "scientism." All responsible scientists hold, with Josiah Royce, that "Man is not merely made for science, but science is made for man." Scientism, however, rejects his statement that the purpose of science is "to bring internal

meanings into harmony with external verification." It takes the attitude that there *are* no internal meanings; that if something has a name, it has been explained; that if a thing has not been explained it does not exist; that a description of the "how" obviates the "why." Scientism exists at its worst in psychology which is applied without any sense of value or meaning or responsible purpose. Unfortunately this kind of psychology has spread into all agencies, including government and education. We find it in the degrading probings into individual privacy through "personality tests," and in the glib and irresponsible "analyses" made by so many laymen of the "psychoses" and "neuroses" of those who are different from themselves.

To avoid reliance on such false science, all of us need to learn what science is and what it is not. We must correct our assumption that science is a mode of knowing that can measure human intangibles such as value and meaning and purpose by present physical science methods. On the other hand, the real contributions of science to present-day thought should be properly evaluated, respected and used, as necessary ingredients of a philosophy of education. For the most part, the major contribution comes to us from the exact sciences, which are constantly enriching our knowledge of the laws of nature. The open-mindedness and modesty as regards present resources to comprehend the nature of reality and the implications thereof which are displayed in the exact sciences should help toward a reduction of scientism, particularly if accompanied by a constructive use of the materials available, and a growing respect for the validity of other ways of knowing which are embodied in religion, philosophy and art.

IN many ways, one may draw a parallel between the atom and the individual, for each term in its root means the indivisible. Today the atom has been split; the indivisible has been divided. Yet at the same time, this small thing has suddenly become of cosmic importance because we have learned how to liberate its energy. In a sense the individual has also been split, or fractionated, but so far we have not learned how to release the energies that lie within him.

Let us consider what these may be.

We say that each of us is a unique individual. This is indeed a literal truth, for it has been calculated that with the coming together of two human beings there are genetic possibilities in the order of two to the twenty-thousanth power. Even considering all the billions of human beings that have ever lived, the mathematical possibilities of combination have been scarcely touched. In addition, each individual experiences different life situations to which, also, he reacts in his own ways. The individual is thus indeed a unique being.

If we consider very young children before they have become self-conscious, we are always struck with the freshness, spontaneity and originality they express in everything they do. A large part of the task of education is to help the individual in whom self-consciousness has flowered to recapture the spontaneous creativity he had in childhood. We are sometimes in touch with this source of individual creativity in dreams. More positively, it emerges as the intuition which prompts a creative genius to make his leap into the unknown. Original contributions to world thought are given by people who have somehow learned to open the channels of creativity which are closed in most of us. Yet within each person, in its kind and to his degree, reside the same powers of creation. If man is to continue to grow, we must learn how to liberate the powers of the individual, not by false analogies of "adjustment," but through the use of appropriate methods for unleashing individual human energy.

The year 1956 should have given us all a renewed faith in the individual. Once again it was demonstrated that the hunger for freedom is innately human, not the product of a single historical era, nor to be eradicated by terror, propaganda or mass education. The fact that the Russian system is undergoing a kind of evolution shows that every system must face its logical implications, which in a totalitarian state focus in the power of one or two individuals over all others. We in America have the kind of freedom that the Hungarians were ready to die for. Yet our democratic system has it logical requirements too. People must use their rights well, if the system is to be preserved; therefore they must be informed, skillful and responsible. 1956 saw the Communist system trying to adjust itself to the implications of its requirements. The American people, however, have not made any dramatic efforts to return to the requirements that lie logically within the democratic system, in which the focus must be on *all* individuals, as human beings.

HOW are we to do this? It seems to me that the process can best be described by a phrase, the educative society. In order to create enlightened individuals we need more than schools. To paraphrase Clemenceau's remark that war is too important to leave to the generals, education is too important to leave entirely to schools. But as generals are important in war, so educators are very important in terms of the creation of the educative society.

There have been a number of indications that there is a growing concern for an education more pervasive than preparation of the young and production of the specialist.

Business men and industrialists, for example, have articulated their felt need for an education which will prepare executives to fulfill their responsibilities. In this connection I must say that this seems mostly to be utterance, for, according to William Whyte's book,

The Organization Man, personnel managers are continuing to recruit young people with sharp but narrow competencies. Also, while individual training needs to be liberalized, the contexts within which individuals live and work need to be opened up equally. Third, we should be clear about why we educate people liberally. Demand by special groups should not be the criterion, but rather the needs of the individual and of society.

Another expressed concern is for what is now called family life education. Parents must be stimulated to realize that what they do for the child will not count for very much unless the parents themselves can demonstrate to him what it means to be alive, curious, and full of wonder and concern for life. In addition, we have a growing preoccupation with the problem of the "senior citizen," in a word, old people. Humanity requires that we do what we can to alleviate their plight, but, to be brutal, most of them cannot be helped, for it is impossible to bring back to life talents which have been allowed to wither, or which have never been developed. Fundamentally, the problem of the aged is educational, and must be tackled before people are old.

There is also growing concern for the problems arising from increased leisure. Yet leisure does not consist merely of more time from our work, but rather of the ability to put that time to use in ways meaningful to ourselves. Lacking this ability, other people usurp our attention, our time and our money. The use of leisure is fundamentally a problem of educating in the individual the desire and capacity to assume command of his own life.

WHAT is the role of the college and university in the creation of the educative society, aspects of which I have been suggesting? Three comments are appropriate. First, continuing education cannot be merely something to which such institutions give just the margin of their attention. It is rather the *test* of what has been done to and for young people. If the process of self-generating education has not been instilled, it is doubtful that anything important has happened in school. Second, the mature person who continues his own education in the home and community is by example a far more important influence than even the best college or university. Third, adults are the decision makers. They found and support the schools, plan and administer the curricula, run the educational institutions and the society in which the institutions exist.

Despite this, I frequently hear administrators and teachers in universities say, "Adult education is not our business; we are here to teach the young and do research." In one sense, they are right. But the trouble is that if the responsibility is interpreted narrowly, adult education is nobody's business. Historically, it has been precisely those jobs which were nobody's business, yet were assumed by the universities, which became their major contribution to the advance of civilization.

I am frequently bemused at the thought of those periods in history when there was a flowering of talent: the age of Pericles in Greece; Florence in the Renaissance, where it was said you could not throw a stone into a crowd without hitting a genius; eighteenth century England, which was in many ways the most wasteful of human talents. These periods of prodigious creativity all occurred in very restricted societies. Yet here in the United States, with half a continent, fifty times the population, and the ideal of equal opportunity for all, we have not learned how to release human creative energy.

This is the bold task for the future. I do not know if it can be accomplished. But if we choose to be guided by the star of individual worth and individual difference, rather than by the false shine of social adjustment and convenient conformity, I think it can be made to come to pass.

CREATIVITY AS PROCESS IN TAOISM*

Chung-Yuan Chang

The Infinite Variety of Experience As Dynamic Expression of Eternal Unity

CERTAIN works, I believe, among the productions of the Chinese artists and poets are particularly representative of the spirit of *Tao*. When we are struck by the utter tranquillity of a Sung landscape or moved by the simplicity and purity of a poet of the Wei-Tsin period, then we come closest to experiencing aesthetically what the Taoist hopes to experience spiritually. We find something inherent in these works that leads us to the inexpressible ultimate that man shares with the universe. There is in them a dynamic process that interfuses with a higher grade of reality. They draw us into a spontaneous and even unintentional unity between seer and seen, a unity which refers, as the Taoist sees it, back to *Tao* itself, the primordial source of creativity. Only *Tao,* the mother of all things, is invisible and unfathomable, but it is through its manifestations, nevertheless, that all things are produced. Alfred North Whitehead said of his central concept, "In the philosophy of organism this ultimate is termed 'creativity' and God is its primordial, non-temporal accident." The Taoist can very well say that his ultimate, too, is creativity, that creativity is *Tao*. Since *Tao* is inexpressible, explaining it in terms of the process of creativity is merely resorting to a verbal convenience, or, more precisely, a verbal inconvenience.

I am obliged to use such a word [process] in attempting to explain *Tao* intellectually. Actual creativity requires no intellectual explanation in terms of process. It is, rather a mere intuitive reflection of things. Our minds are simply [a] mirror, reflecting the "here and now" of creation. Such, according to the Taoist, is the process of creation. But this creative reflection can only be understood through private intuition. Enlightenment does not come from without. It comes only from within. Enlightenment has been likened to an inward flood:

> "Last night the spring rains came rushing to the river.
> Today the huge ships float like clouds upon the stream.
> Vessels that could not stir before
> Now travel freely in the middle of the current."

With an awareness of these rising currents within ourselves we may come to an understanding of the creativity of *Tao*. This concept is of self-realization, which requires no outward instrumentality to effect its inward processes. *Tao* is the inner reality of all things. It depends upon neither external God, nor concrete substance, nor abstract principle, as various other Chinese schools of philosophy maintain. Such would imply a limitation upon *Tao,* and *Tao* is limitless.

When inner reflection takes place it fulfills the process of manifesting ultimate reality. This process is direct, immediate, and spontaneous. It is as the wild geese that cast their images upon the water completely without intention. Such spontaneous reflection is the creativity of *Tao*. But always *Tao* itself remains invisible and unfathomable. What we grasp, what we see, is simply its manifestation through reflection. The Taoist says: "*Tao* never acts, yet through it nothing is undone. . . . All things create themselves."

But to understand creativity as a process we must see *Tao* as having penetrated into infinite multiplicities and into the manifold diversities of existence. In unity there is the infinite interfusion of diversities but in each diversity we find the total potentiality of unity. Kuo Hsiang, the Neo-Taoist of the 4th century, illustrates this concept thus: "A man is born but six feet tall. . . . However insignificant his body may be it takes a whole universe to support it."

Let us consider this basic groundwork of creativity —unity within multiplicity. According to the Taoists it is only in the world as manifested that we are con-

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* Condensed by permission of author and publisher from a chapter in a forthcoming book reporting the 1956 Eranos Conference, to be released in June by Rhein-Verlag, Zuirch.

fronted with polarities and multiplicities. In the absolute realm these opposites and diversities are completely interfused and identified. Chuang Tzu says: "If we see things from the point of view of their differences, then even our inner organs, which lie next to one another, are as far apart as the states of Ch'u and Yüeh. But if we see things from the point of view of their identity, then all things are one." To see things relatively is to recognize them in their diversities; but in an absolute sense, diversities are reconciled into unity. The former represent the All, the latter represents the One.

Chuang Tzu gives us an illustration of this idea in the centipede. From the relative point of view the insect, of course, does have its hundred or so different legs. But from the higher point of view there is a unification of multiplicity. The coordinated movement of all the legs is a manifestation of unity. From this unity we see the centipede as a whole.

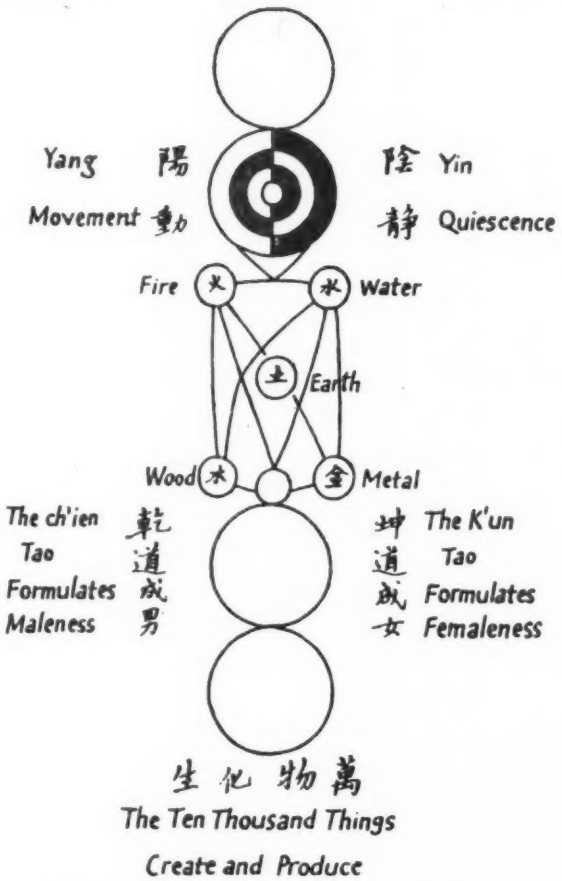
In the process of creativity each particularity retains the potentialities of the unity. The human eye fails to see this unity and detects only its manifestations. But in each instance of creativity there is the infinite potentiality of unity. "Heaven and earth is nothing but a finger, and ten thousand things is nothing but a horse," Chuang Tzu says. So too, feels the Ch'annist who, lifting his finger, perceives the universe to move within it. The lifting of a finger is the slightest of gestures, but when it is viewed from the vantage point of the absolute moment it generates the power of the divine and blossoms into creative vitality.

To see unity in multiplicity is one approach to the understanding of creativity. There is another approach immediately and inseparably related to it. Unity can never remain static. It is both static and dynamic at once. We must attempt to see the changeless within the everchanging. When unity remains within itself it is changeless. When it reflects itself it creates, and changes manifest themselves.

The Logicians of the time of Chuang Tzu said, "There are times when a flying arrow is neither in motion nor at rest." The Taoist would say that the flying arrow represents the changeless within the everchanging. In a relative sense, which is conditioned by space and time, the arrow moves from point to point, and from one second to another. Thus we detect its movement. But, from the absolute point of view, which is free from temporal and spatial limitations, there is no apparent movement at all. Thus we see its changelessness. The arrow moves all the time, but at the same time it does not move at all.

When we are enlightened we understand the everchanging changeless. We see changes as an accumulation of units, or monads, or an indefinite process of repeating and adding things, but the changeless is an invisible, indefinable, complete oneness. The spiritual man does not rigidly attach himself to particularity, but interfuses with the whole. He makes himself one with every change. Thus he integrates himself and wanders with solidarity. He is a synthesizer of variations. All distinctions become meaningful. Each change appears in the new situation full of meaning.

When the changeless remains in itself and with itself it is continuum, quietude, oneness. When it subjects itself to change it creates. Change is not something imposed upon it, I must make clear, but a product of self-generation. In the manifestations of the changeless we see its reflection. This reflection is derived from the boundlessness of space and the endlessness of time. From the changeless to the everchanging we see creativity in the process of transition; from unity to multiplicity we see creativity in the process of concrescence. Both are in the grip of what Whitehead has called the "creative advance into novelty." In the absolute realm of creativity they are identified.



This idea can be illustrated by the T'ai-chi Tu, or The Chart of The Supreme Ultimate, of Chou Tun-yi. In the explanation of the Chart Chou says: "That which is the Ultimateless, yet produces the Supreme Ultimate. The Supreme Ultimate moves and creates yang. When the movement reaches its utmost it returns to quiescence. Movement and quiescence alternate and thus mutually originate one another. When

yin and yang function distinctively two forces are clearly revealed. By unification yin and yang transform themselves into fire, water, wood, metal, and earth . . . [in fact] the five elements are the same as yin and yang; yin and yang are the same as the Supreme Ultimate. The Supreme Ultimate primarily is the Ultimateless. When the five elements are produced each possesses its specific nature. The reality of the Ultimateless, the essences of the two forces and the five elements, all unite wonderously so that consolidation ensues. The Ch'ien principle becomes maleness and the K'un principle becomes femaleness. By interfusion the two forces create ten thousand things. Through their producing and reproducing ten thousand things transform themselves and reach no limitation."

From the Taoist point of view the Ultimatelessness of the universe is duplicated in man. The man of enlightenment achieves the Ultimateless. When he contemplates he sees ten thousand things as pure complete one. He intuits the changeless within the everchanging and identifies with both. Being enlightened, he is free from the entanglements of time and the attachment to things. This interfusion and identification between self and non-self is the source of all potentialities, all possibilities, and moves in the realm of absolute reality. Thereby his reflection is filled with the creative spirit that animates all things. Such effort is a pure, true immediate reflection of ultimate reality. We call it the process of creativity.

Cultural Values and Human Nature

THERE is a current need, especially in Western culture, to universalize human nature, and thus find some level of experience wherein all individuals are the "same" or "equal," and yet retain their individuality and uniqueness.

Is such a concept of a universal human nature intelligible or useful? We have come to appreciate that not everyone responds equally to the symbol of an abstract differentiated human identity. Universal cultural values are extremely elusive. The propensity to know oneself is peculiarly Indo-European; it may be conceived as a gestalt describing the direction of Western culture, a kind of integrated living myth which is only understood as one becomes part of it.

We may thus distinguish between a "real" universal human nature, and the universal human nature which is a Western cultural projection. The latter has been variously described. On a behavioristic level, all humans appear to have certain requirements. They all eat in some way, and all have stomachs and mouths, although eating and the possession of stomachs do not distinguish the human from the non-human organism. It is in the specificity and totality of these functions and structures that the human is identified. However, when we try to establish the "nature" of man as a norm inductively derived from behavior patterns, we have to make special allowances for the non-human who might qualify as human (since the monkey may eat from a table), or for the groups of humans who must be disqualified because of their failure to fulfill the established behavioral requirements (as primitives who might not be fussy about the state of their meat).

If, then, objective measures fail to satisfy us, what of the efforts to establish a universal human nature on a subjective basis? Such an approach holds that man is man by virtue of his ability to "think" and "abstract," his faculty of awareness, especially awareness of self, and his power of projecting peculiarly human emotions. In this view, the only test of human nature is the inner individual certitude which is effective in human relations. The difficulty comes, however, when the inner certitude is not effective. We are able to share emotions and thoughts with others, but are these feelings universal? Do we not choose those with whom we share like experimental worlds, avoiding those who are unlike us?

As mankind develops, natural hostilities expressed through these avoidances are resolved by means of war, and, perhaps, peace. Such resolution implies an imposition of one order upon another. X order predominates because it is the better; it is better because we feel it to be so, and because it has in fact predominated. There is thus a desperate note to human conflict, because defeat implies lack of worth.

From another point of view, long known in the East, knowledge of the self should be personal and immediate—not to be symbolized, affirmed or denied, or even communicated. It should be so certain that any expression of it *as* certain constitutes doubt.

When the Greek said "Know thyself," he established as a supreme functional value the denial of the self; he expressed a doubt that he was even a self to know. If we shall find it, the self will be the product neither of rational discovery nor of intuitive contemplation, but simply of being. Human nature then will rest upon the experience of the self, and of the identity of the self with the world as a whole. If anything makes us human and ourselves, it is simply in being ourselves and therefore in being human.

—Carter Zeleznik, Addis Ababa

THE PROCESS OF AGREEMENT

Henry F. Pommer

Alleghany College

A Suggested Curriculum for Integrated Education

IN a world too often torn by disagreements, men need constantly to reexamine the amount of agreement that is possible, and how it is to be achieved. The problem contains many aspects, such as the importance of unconscious motivations and the effectiveness of non-violence in accomplishing social change, but those which will be here surveyed are the process of making responsible decisions and the encouragement of that process through collegiate education.

In making responsible decisions and in teaching others to do so, we must have in mind not so much a blueprint as a sketch, not so much a product as a process. Making such decisions in any major area of thought has never been easy. Always it has involved sifting what is received from the past in order to separate the true from the false, the better from the worse. What survives the sifting must then be acted upon so that it may have contemporary life.

Some persons deny that the sifting can be done rationally, or that it is publicly verifiable. At a popular level, such skepticism appears in questions like "Who is to decide what research is meritorious?" or "Who is to decide that one novel is better than another?"

THE little question, "Who's to decide?" occasionally implies only a proper humility on the part of the speaker. More often, however, it throws down the gauntlet of complete skepticism by implying, "You and I disagree, but no one can decide which of us is correct. There are no real standards, so let's just be polite about our personal prejudices."

Facing risks, and with faith, I will pick up the gauntlet. I maintain that the intellect discovers standards in the light of which competent people can place major and minor questions in three categories:

First, some questions are vague in their wording or absurd in their implications. For instance, "Does democracy give its citizens maximum security?" (What do you mean by *democracy* and *maximum security*?) "How much greater than *The Caine Mutiny* is *Moby-Dick*?" (Do you expect an answer like "ten degrees greater" or "twice as great"? Either would be absurd.) After they have been reformulated, vague and absurd questions can be transferred to either of the two other groups.

Second, some questions are unanswerable because the knowledge needed to decide them is not available or does not exist. For instance, "Are there beings like us on planets of other suns?" Or, "Precisely how large was the population of northern Britain when the first Roman wall was built across the island?"

Third, some questions are answerable because the knowledge needed is already available, or can be acquired. For instance, "What are the relative merits of milk and beer for human diet?" "Which is more likely to facilitate the decrease of tuberculosis: research into its incidence in Elizabethan London, or intensive case studies of one thousand patients hospitalized last year?"

Not all questions of this third category are decided with the same kind of knowledge. Sometimes the knowledge needed is analytic statements or axioms, such as that three plus four equals seven. Sometimes it is an inductive generalization based on and tested with sense data: "Unless they are in rigid containers, gases expand when heated." At other times the knowledge must be a value judgment, such as that it is wrong to inflict pain on any creature "just for the fun of it."

IF a proposition of the first sort (an analytic statement) has been carefully defined, it can justifiably be regarded as reliable. But propositions of the second or third type can only be regarded as having some degree of trustworthiness. The current test of how closely they approximate truth is immediate experience, and the degree to which a given proposition is accepted by those whose experience makes it reasonable to consult them. Such a consensus of experts is by no means infallible, but it is highly useful as long as the experts are alert to fresh evidence, and dissenters are tolerated.

Truth might be defined as an all-embracing system of concepts which are logically interrelated, which correspond to all sense data, and which will never be changed by the consensus of informed men. Some people are disheartened by the recognition that we do not possess such truth. Instead they should recognize with gratitude that we do have several fruitful and important kinds of knowledge. Perhaps some day they will be seen to be equivalent, or inextricably and meaningfully interrelated. In any event, as precisely analyzed statements, as the uniform insights of experienced minds, they are the bases of responsible decisions. That we lack the noonday sun does not mean that we walk in utter darkness.

In the absence of full truth, our decisions inevitably involve the risk of being wrong. In order to make them we need a spirit compounded of humble self-confidence, the ability to face insecurity, and a willingness to venture. This spirit is the faith held in common by the mature atheist, agnostic, or theist, by the scientist and the man of arts. It is the feeling that one could more easily justify this alternative than another, that one would rather face these consequences than those. We cannot wait for full truth in order to act; we must act in order to move towards the place where we believe truth is.

Knowingly or unknowingly, all of us perform an act of faith by agreeing with the majority that a cause is just, or, conversely, by disagreeing with the consensus of experts for the sake of a lost cause, or a cause new born. One can only perform one's act of faith as intelligently and effectively as possible, and then await the verdict of time, which may not be rendered during one's life. No matter what the fashion or degree, all of us must live by faith.

Is Mr. Jones' faith concerning fertilizers as reasonable as Mr. Smith's? The answer depends on the comparative knowledge of the two men. Who *can* decide on the relative merits of their knowledge? He whose own knowledge is relevant to the situation. Who can *best* decide? Whoever has the largest quantity of relevant knowledge, and knowledge of its relevance. Who *must* decide? Perhaps none of us need decide the issue between Jones and Smith. But other issues we cannot evade. Under the theory of a monarchy or aristocracy, only a few can make decisions affecting many people; under the theory of a democracy, each of us must do so. In religion and education also, each of us must take the risk of decision.

In some such way as this the great men of the past made their decisions, and we honor them not only by making our own decisions responsibly, but also by teaching others to do so. Yet can any institution really teach the skill of making decisions?

LET us limit our attention to the liberal arts college. More than any other institution it has the responsibility of training students to make wise decisions in many areas of experience.

It is customary to separate the liberal arts curriculum into two parts, one in which a student specializes in a single discipline, the other in which he is introduced to a wide diversity of subjects so that he will have at least a minimum understanding of the chief intellectual interests of man. It is the second part which must bear the primary responsibility for teaching the skill of making responsible decisions, since it permits a wide accumulation and testing of the three kinds of knowledge already described.

In the second part, often called "general education," the organization of courses usually reflects the longer-standing organization of the faculty into three divisions; the humanities, the social studies, and the sciences. While there is some intra-departmental integration, very few general education courses combine material from one division with material from another.

It is entirely possible that we need to abandon this conventional system of general education courses in favor of a more searching and fruitful study of problems which cut across divisional lines. A curriculum of this new sort might consist of the following four courses which emphasize those topics about which men most warmly disagree:

1. *What is Man?* This course would draw most of its material from biology, psychology, anthropology, sociology, history, religion, and philosophy. It would present the significant questions and answers which have developed concerning the sources, growth, and future of our race and of us as individuals. How has the human race evolved? Does man have an essential nature? Of what value for the study of man are introspection, hypnosis, chemical and physical analysis, psychoanalysis, the description of behavior, statistics? What is known on such topics as learning, motivation, free will, mind-body relationships, immortality?

2. *What is Real?* This course would be concerned with problems of both truth and reality. Starting, perhaps, with a study of epistemology, it would examine the kinds of knowledge discussed previously. While discussing tests of truth, students would examine specific or alleged truths from various fields; *e.g.*, the nature of light, the mind-matter dualism, the Ten Commandments. The students would have to weigh the functions of empiricism, imagination, reason, and faith; they should consider the nature, extent, and implications of order.

3. *What is Good?* Here the main contributing fields would be psychology, ethics, religion, and political science. The teaching would emphasize both the goals and the techniques of the good life: What intrinsic values are there, and how are they to be achieved both in individual and in societal life? How do individuals and society interact in striving for the good? Is faith in a given form of government necessarily blind, or can it be clear-visioned?

4. *What is Beautiful?* In this area aesthetics, literature, music, painting, and the other arts, would be studied. Classes would examine the nature of beauty in the abstract, the understanding that must be brought to its concretions and that can be carried away from them, the pleasure which beauty confers, and the obligations which it imposes. The relations of beauty with the good, the real, and the nature of man would be considered.

Throughout all four courses would run a steady interweaving of philosophical speculation with contemporary facts and theories. Thus, the best of Freud's thinking would be canvassed in "What is Man?" Industrial management, political organizations, and international relations would be analyzed in the light of "What is Good?" The organization of stellar space would be studied in one way in "What is Real?" and returned to for a different purpose in "What is Beautiful?" The student would by no means be deprived of the most meaningful data now taught in general education courses in science, government, fine arts, and so on through the usual lists. But the central emphasis on major perplexities is suggested by the titles given the courses.[1]

Such a curriculum, if it could ever be taught adequately, might bring us closer than we have yet come to fulfilling the four functions that every educational community should perform. First, such a community should learn and teach facts, plus a respectful distrust of facts that have not been rationally interpreted. Second, it should learn and teach generalizations and interpretations, plus a respectful distrust of all generalizers and interpreters, all authorities. Third, it should exemplify reflection—examining a proposition minutely for all its implications and consequences, taking time before making decisions, seeking the criticism of others—but also a respectful distrust of reflection which does not act. Fourth, it should exemplify action in every appropriate area of life, at the same time showing respectful distrust of action which is not based on informed reflection.

Facts and interpretations can be drilled into creatures who have memories and the will to learn. Independent reflection and action, however, cannot be taught directly. The best that an institution can do is to bring into the same community teachers and students who practice these skills along with teachers and students who don't, with faith that the better will stimulate the worse more than the worse will stultify the better. The better have the ability to make responsible decisions, for being well acquainted with facts, interpretations, reflections, and action they are ready to select the answerable questions and to solve them.

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[1] Such a proposal raises certain obvious problems, including the bulk of material to be covered in the courses and the difficulty of creating a staff to teach them.

In a college where the normal student load is fifteen hours per semester, each of these year courses might well be scheduled as a five-hour course. Two of the courses would be required of freshmen, and two of sophomores. The student would also be required to demonstrate upon entrance, or achieve soon thereafter, a high degree of competence in skills such as writing and reading, and probably a foreign language or mathematics. But the problem of the bulk of material to be covered in each of the four central areas could not be solved simply by assigning five hours of credit to each course, by setting the courses in the proper sequence, and by presenting them to students who have the requisite skills. In addition, higher-than-usual standards would have to be set for both quantity and quality of student performance, and an unusually capable faculty would have to be developed.

The development of such a faculty might be hastened in numerous ways. First, a sufficient number of teachers enthusiastically interested in giving the program a trial would have to be found. (Probably only a small proportion of extreme logical positivists, emotivists, behaviorists could be included. Most of the faculty would have to agree at least that the search for truth, goodness, and beauty is one worthy of the effort involved.) Second, each teacher would be given a summer grant to free him for close collaboration with the other teachers in the same program. From time to time during the given summer, the entire staff would meet at the college camp or some other quiet place for leisurely discussions of plans and problems. Between meetings the individual teachers would not do research, tour New England, raise vegetables, build houses, or advise local management on personnel problems; they would do that reading and thinking which would best broaden their acquaintance with important disciplines in which they did *not* earn their Ph. D.'s. Third, during the first year of the experiment, each teacher's load would be limited to two sections of the course he has chosen to "specialize" in. Because of this lightened load, he would have some time in which to do that unforeseen reading and planning which a new course always demands. Sections would at the most contain fifteen students, and each section would be taught by two instructors, each from a different division (social studies, science, humanities). These sections would usually be taught by discussions, but might be brought together once or twice a week for lectures if good lecturers were available.

Material and Immaterial:

The Brain and the Mind

DURING the annual meeting of the American Association for the Advancement of Science in New York City in December 1956, Dr. Irvine H. Page of the Research Division of the Cleveland Clinic Foundation delivered a paper on "The Chemistry of the Brain," which was published in its entirety in the April 19, 1957 issue of *Science*.

In this, Dr. Page traces out the development of neurochemistry, which has only since the nineteen forties grown into an active movement designed to complement clinical neurology and psychiatry by objective study of brain chemistry.

Clinical studies show that many of the functions of the body that are maintained homeostatically are in part but seldom wholly under control of the nervous system. For example, in the case of normal blood pressure, although the vasomotor centers in the medulla seem to control it almost completely in ordinary circumstances, other factors may be at work, and they themselves are subjected to a variety of controlling mechanisms, most of which may be chemical. Psychic functions may have a profound effect on these centers, but the mechanism by which they act is quite unknown. It has been demonstrated that the control of blood pressure is, in the final analysis, largely neurochemical. There is also an important possibility that the nervous system does more than exert control by means of transmitted nervous impulses; it can regulate directly through chemical secretions produced by nerve cells.

Dr. Page considers at some length research with the drugs which produce mental disturbances, such as lysergic acid, its antagonist, serotonin, and reserpine. The problem of the functions of these in the brain is far from solved, but it is currently providing a nidus around which thinking about chemical reactions and the psyche revolve. In Dr. Page's view, it is such approaches as these that will provide many of the keys to the solution of the problem of mental disease, and they have certainly helped greatly to make the field of neurochemistry real. They have also pointed up the fact that a wave of uncritical enthusiasm for the application of neurochemical principles in the psychiatric field holds some danger of premature conclusions.

The second part of Dr. Page's paper is devoted to a consideration of the mind and neurochemistry. He makes the point that the nature of mind is no clearer today than when it was first propounded. Although much fruitful speculation and experimentation has been carried out under the "switchboard" concept of brain function, the jump from making the switchboard more and more complex until reason appears is one he finds difficult to make, nor does he find sensation and thought to be equivalent. As for the confidence with which many physicists approach the problem of the nature of thought, "Feedbacks, cybernetics, molecular memories, etc., are indeed impressive concepts, but so far they carry no conviction to me. The brain is no more than a physical mechanism which without the mind is not unlike the so-called 'electronic brains' of industry. But without the guiding mind the brain comes to little. This is a problem not to be approached lightly, because the world of belief, of faith, of beauty, of happiness is at stake."

Study of the mind-body problem is at least under investigation, even though it is far from solution. "Whether mind is only another property of that remarkable stuff called protoplasm, or whether it is an intangible stuff not lending itself to such material approaches as those of science will be answered eventually; the point is the search is started. Whether the brain secretes thought or is only the substrate which provides the means of expressing it is another of the persistent problems. But the least common denominator is that the nervous system requires energy which is chemical, and this is subject to scientific analysis."

Dr. Page believes that one of the reasons why the chemical approach to the brain has been avoided lies in an unconscious fear that it may cast doubt on the religious nature of man. "The fear must stem from what seems to be a current trend in the direction of dialectical materialism; a trend I might add that is at the basis of much anti-intellectualism and animosity toward science. . . . Materialistic-naturalism is currently prevailing among many of our people as a result of science. . . ."

Proceeding to a consideration of the relationship between the brain and thought, Dr. Page writes, "The chemistry of the brain seeks to define the mechanisms which result in transmission and integration of nerve impulses and concurrently define their association with thought, no matter what that association may be. The danger quite obviously lies in the nature of the problem of thought itself."

Although thought has been frequently characterized as a property of protoplasm just like any other, and although it can be influenced by chemical reactions and seems to be able to influence them in turn, Dr. Page is not convinced that it is subject to methods of analysis as we now know them, and to the reproducible experiment. He says, "Might it not be that in this problem we are approaching the ultimate where the same type of problem of causality arises as occurs in the case of quantum theory and the uncertainty principle? Even measurable data have lost their absolute certainty in this case. But how do we even measure values and emotions which constitute

much of the world in which we live?

"Is science, as Francis Bacon thought, an image of truth or, better, reality? It is constituted of sense experience and as neurochemists we should immediately be warned. Sense experience acts as transport mechanism separating us from reality and possibly correctly informing us of it. Only the images of reality formed and transmitted by the tenuous thread of the nervous system reach consciousness. How closely do they mirror absolute reality? Scientists are likely to forget they operate on faith exactly as do religions.

"I conclude with the hope that, for the small part we play in the shaping of things to come, the neurochemist will pursue his science to its utmost but never forget that the problem of dualism of body and soul may not be solved in material terms only, and that on its solution hangs the fate of society. . . . I personally see nothing to persuade me that the functions of the brain are not the functions of protoplasm and that these functions subtend the material and the transcendent, that there is the necessity to include in our philosophy of biology both those material attributes which are our science and those immaterial which are our values. It is the amalgamation of the two that will erase the abyss, which has so destructively separated science from human reality. . . ."

—E. B. Sellon

The Peak Experiences

IN his Presidential address, Division of Personality and Social Psychology, American Psychological Association, delivered in New York, Sept., 1956, A. H. Maslow of Brandeis University discussed what he calls "peak experiences." These are moments of highest happiness and fulfillment which come in love, mystic or oceanic, or nature experience, the aesthetic perception, the orgasmic experience, etc. These moments, according to his studies, are characterized by a particular kind of cognition which he calls B-Cognition or Being Cognition. This is in contrast to D-Cognition (for Deficiency) which is organized by needs of the individual in which his own motivations and desires shape and color what he perceives.

In B-Cognition the percept is exclusively and fully attended to with "total attention." It is seen with "care" as a mother watches her baby, with fascinated attention and with repeated examination which gives "richness of detail and many-sided awareness of the object."

In ordinary perception things are seen as part of the world and in classes, whereas in B-Cognition the object is seen as unique with all its idiosyncracies, non-comparing, non-evaluating or judging. To perceive an object abstractly and classify it means not to perceive some aspects of it. B-Cognition avoids this and is child-like in that the object is seen with a freshness, as though for the first time.

B-Cognition makes human-irrelevance more possible and thereby enables us to see more truly the nature of the object itself. In such experience there is an absence of projecting human purposes on the object of perception so that it might be seen in its "own Being rather than as something to be used, or something to be afraid of, or to be reacted to in some other human way." Western psychology is based on the assumption that all cognition is motivated, that the world can be seen only from the vantage point and interests of the perceiver. This is contrary to the writings of many philosophers, theologians and psychologists of the Eastern world. Maslow's findings indicate that in "self-actualizing" people (unusually mature persons whom he has studied) and in average people in peak experiences, "perception can be relatively ego-transcending, self-forgetful, ego-less. It can be unmotivated, impersonal, desireless, unselfish, not needing, detached. It can be object-centered rather than ego-centered."

The peak experience in which B-Cognition occurs is felt as a self-validating, self-justifying moment which carries its own intrinsic values with it. Subjects describe such experiences as so valuable that they make life worth while by their occasional occurrence.

Such experiences are only good and desirable, with never an element of evil or pain. Maslow suggests that this may have tremendous philosophical implications. If the nature of reality is perceived more clearly in B-cognition, because it is motiveless and more independent of the ego and its colorings, then perhaps "the whole of Being is only neutral or good, and that evil or pain or threat is only a partial phenomenon, a product of not seeing the world whole and unified, and of seeing it from a self-centered point of view," as many philosophers and theologians have affirmed. A God able to contemplate and encompass the whole of Being perhaps must see it as good, just, inevitable. If we could be God-like in this sense, then we, too, out of universal understanding would never blame or condemn or be disappointed or shocked. This is the way that self-actualizing people react, and the way psychotherapists try to react to their patients, and the way all of us react in peak moments. The person at the peak is godlike in the complete and loving and uncondemning acceptance of the world and of another person.

The peak experience is characterized by a complete, though momentary, loss of fear, anxiety, inhibition, defense and control, a giving up of renunciation, delay, restraint. The person becomes more a unity, more integrated and self-consistent after the experience. His powers are enhanced and coordinated and can be used with unusual ease. He may be startled by his unsuspected skill, confidence, creativeness, perceptiveness and virtuosity of performance. He is more ego-transcending and self-forgetful. This involves a true integration of the person at all levels, ego, id, superego, ego-ideal, conscious, unconscious, etc.

His study of peak experiences has led Maslow to redefine self-actualizing. Previously he had thought

of the term as characterizing certain rare people in an all-or-none way. Now he sees such people as having more frequent peak experiences than the average, but no essential qualitative difference in the experience itself. He now thinks of self-actualizing as an episode or spurt.

Maslow points out the problems in seeking external validity of the peak experience. His studies describe subjective experience in a phenomenological fashion. It is ticklish to find an objective measure of whether or not the subject's perceptions are actually truer or more full, as it seems to the subject. Maslow suggests that if self-actualizers do perceive more efficiently and fully they might be used as biological assays, or that the perception in peak experiences of more average persons might be a guide to the nature of reality.

Another source of validation is in the unanimous reports of subjects that after effects occurred in their personalities. They all agree on therapeutic effects, changes of self-perception, improvement in relations with others, change of views of the world, release of creativity and spontaneity, desire to repeat the experience as it is remembered as very important, the feeling that life in general is more worth while.

Maslow thinks it clear that B-Cognition is no substitute for the routine procedure of science. The problems of checking, choosing, rejecting, confirming, and externally validating remain subsequent to the flash of insight. The two types of experience supplement each other. But he finds it incomprehensible that psychologists have by-passed peak experiences or remained officially unaware of them, or even worse as in the case of objectivistic psychologies, denied a priori the possibility of their existence as objects for scientific study. Maslow concludes that peak experiences "are commonplace to all but psychologists."

—S. J. Nicholson

The Evolution of Religious Thought

THE fundamental purposes of a university's religious program are considered by Cornelis W. de Kiewiet, President of the University of Rochester, in an article entitled "The Sense of Moral Purpose," which appeared in the University's *Review*.

President de Kiewiet writes that he was surprised, when he first came to the University of Rochester, at the undeveloped character of the religious program, since he felt that one of the major responsibilities of the university was the relationship of knowledge and technology to "all the qualities and aspirations which make man a spiritual as well as a physical being."

Consideration of the contributions which have been made by different individuals to the whole corpus of religious teaching, from the writers of the Old Testament on through the New Testament, Egyptian monks, St. Augustine, St. Benedict, down to Martin Luther and finally Albert Schweitzer, has led President de Kiewiet to conclude that "Religion turns out not to be something that is discovered and enunciated once in a final form. It really is a stream of considerations which flow through the ages refreshed by new thought, new moral discoveries and new acts of association." And he considers that this is an excellent reason for the encouragement of religious thought and activity in the University.

"I am deeply convinced that we need new values by which to guide our acts and fresh eyes with which to see our fellow human beings. I feel that the great moral discoveries that have been made by deeply spiritual men through the generations are either not in themselves adequate, or have not obtained a great enough purchase over our own minds for us to be sure that we are moving toward greater brotherliness or a deeper regard for human dignity and those relations between men which add up to peace.

"Since the war we have endured a number of profound moral reverses of which only time can measure the magnitude. The first was the eclipse of Gandhi's spirit, . . . of his moral formula for the conduct of human relationships within society. It may be too early to say this, but for the time being no new conception of human relationships is likely to come from an India which is traditionally one of the great religious and moral centers of the world. . . . These things are not said in a sense of blame but rather to make the point that we have not yet found the means to use our own moral and spiritual discoveries.

"And so I would argue that religion, like so much else, is full of unfinished business. Recently I gave a talk in New York City where I used the following words: 'A high responsibility for the humanities is the formulation and the adoption of a religious attitude that is consistent with the best in our moral and political tradition, yet which also enters with a new inspiration into neglected and unexplored areas of our relations with other men. . . . Some of the vision has to be new, and the words in which it is expressed will not be enough if they are merely American, or Western or even Christian.'

"Some people are inclined to argue that religion has failed. It is also possible to argue with much greater force that we have not advanced far enough in religious thought and practice for us to speak of failure. I have not used terms that are sectarian or dogmatic . . . because I believe we should examine the possibilities of rediscovering the ancient conviction that religion was something that bound men together. Our tragedy is that religion has become fractionated and therefore one of the divisive forces in the modern world.

"Today education should labor as never before to confirm men and women in the sense of moral purpose. . . . A university, after all, is at its best a place where all mankind can be studied, and where it should be possible to establish new and more acceptable equations between the religious discoveries of the world's peoples."

—Warren D. Jefferis

NEWS AND NOTES

TO the editorial desk occasionally come manuscripts which formulate ideas so challenging that sharing their stimulation with the reader becomes a major consideration, even though—and just because—the argument may carry us beyond the range of the familiar. We believe our readers will agree that the article by Andrew A. Cochran in this issue of MAIN CURRENTS is unusually challenging.

The notion that a biopsychological field may presently be established is gaining ground. That this field should operate mainly through the chief constituents of protoplasm follows from all we know of fields generally, and the test materials which disclose their workings. The reader will judge for himself the effectiveness with which the author of "The Quantum Physical Basis of Life" has assembled considerations which support the additional ideas presented. In his original manuscript he refers to two examples of the multiple valence capacity of carbon: large size of molecules, and diversities of combinations. As to the first he mentions hexacontaine, in which sixty carbon atoms form a stable molecule with a hundred and twenty-two hydrogen atoms. As to the second, he remarks that in 1930 no fewer than 300,000 compounds of carbon with other elements were known, whereas the known compounds of all other elements were fewer than 60,000.

The article bears upon a puzzle too seldom discussed. If the physical universe is to dissolve away and vanish into a state of maximum entropy, will not the same state of affairs then exist which obtained before this present universe appeared? If so, are not universes recurrent phenomena, as the Indian doctrine of *kalpa* and *pralaya*—cosmic waking and sleeping—declares them to be? If structural order (negative entropy) is latent in the non-material aspects of nature, then may it not re-assert itself, age after age? Are we then not obliged to suppose that the non-material or noumenal reality has dominance over the phenomenal ephemeral expression?

IN the forthcoming volume twenty-five of the Yearbook of the Eranos Conference, will appear among other contributions a remarkable exposition of "Creativity as Process in Taoism" by Dr. Chung-Yuan Chang. We are privileged to offer in advance an abstract of the central concept in this paper. The original is some twenty-five pages of lucid writing and rich documentation which connects the thinking of Whitehead with that of Laotze. Dr. Chang is at home with both. He sees that new meaning is given to such ancient ideas now that the scientific world is employing empirically justified concepts of a polydimensional world. What was a hundred years ago mere obfuscation, now begins to make sober sense. In space and time an object is in motion. As Einstein somewhere points out, in a four-dimensional contemporal world the same item is not a temporal or transient event. It is no longer nonsense to say: "The arrow moves all the time, but at the same time it does not move at all." In these new terms of science, rethinking is most urgently called for in psychology and in religion.

QUITE another kind of Chinese scholarship has registered in the news lately. Dr. Tsung Dao Lee and Dr. Chen Ning Yang suggested an experiment which, when conducted by Wu, Ambler and others showed that principles of invariance postulated for the behavior of elementary particles do not hold good. That form of symmetry of nature called parity was thus challenged, in this one instance. (An admirable account of this experiment, by J. D. Jackson, will be found in *Physics in Canada,* Vol. 13, #1, pages 10-17.) From the excitement in the popular press, one might suppose the heavens themselves had fallen. One might conjecture that a few mathematical physicists had put a stop to the orderly progress of the universe: Lee and Yang contra Yang and Yin, so to speak! Right on the heels of this cosmic calamity *Pravda* (says the New York *Times,* Feb. 21, 1957) reported than on December 11, 1956 Professor L. D. Landau had submitted to a leading Soviet journal of physics a theory confirming parity and thus restoring order, even before Wu and Ambler had impaired it! (Whether this confusing state of affairs is due to the cold war or properties of space-time is hard to say.) According to Landau, in the microcosm of particles it is as if one's image in a mirror is a double reflection. It is not only left to right, but made up of anti-nuclei and positrons, instead of the nuclei and electrons of which one is composed, in fact. Hence parity is restored, and the universe may once more be believed in, as a meaningful cosmos. For the present the Tao and Yang and Yin have withstood the assaults by Messrs. Lee, Yang and Wu.

EDUCATIONAL *Quest* is the very newest of the little educational journals. (Memphis State College, Memphis, Tennessee, quarterly, $1.50.) These ventures seem to indicate that the N.E.A. journals, *Schools & Society,* state education professional house organs and other long-established magazines are not up-to-date, in terms of the present growing local discontent with general and specialized education. *Educational Quest* is incomparable. It rings with wholesome candor. If its editors can provide more and more the constructive new materials now available, with the same ardent spirit as they afford wholesome criticism, they will not only be heard. They will be listened to.

—*F. L. K.*

REVIEWS

A Whole View of Development

GEORGE ALLEN & UNWIN, Ltd. are distinguished among publishers by the admirable books on biology which they publish as texts and as manuals for the philosopher of nature. The thoroughness with which they and their authors perform this function is exemplified by *Chromosome Atlas of Flowering Plants,* by C. D. Darlington and A. Wylie. This first appeared in 1945, and covered the chromosome numbers of cultivated plants. The second edition (which we hope to review later) has been extended to cover the whole of the Flowering Plants, embracing in this one volume over 17,000 species. Since the chromosome numbers, shapes, sizes and behaviours are specific (though in annuals extremely unstable), the importance of such studies in understanding the mystery of species is evident. *Chromosome Botany,* by C. D. Darlington, is also issued by Allen & Unwin.

They have now added to *How Animals Develop,* by C. H. Waddington, an invaluable and comprehensive, *Principles of Embryology,* by the same author, who is Professor of Animal Genetics at the University of Edinburgh. 186 line drawings illuminate the text, which is comprehensive in scope and extremely lucid in exposition. The first part deals with the facts of development generally, then in a few important more primitive cases (echinoderms, ascidians and amphioxus) more closely, with a chapter on spirally cleaving eggs, goes on to insects, the vertebrates, the embryonic axis, embryo formation in primitive fish, teleosts, reptiles and mammals, and so to organ development in vertebrates, growth and regeneration. The second part traces through the fundamental mechanisms of development: activation of the genes by the cytoplasm, synthesis of new substances, plasmagenes, and finally individuation.

Readers of this journal will find many passages of great importance, indicating the shift of emphasis from mechanistic interpretations to the new holistic treatment. Naturally the contributions of analysis of parts is indispensable. Thus the tracing of connections between specific hormones and the metamorphosis of insects begins to supply knowledge of that extraordinary business. But the author keeps the whole so well in view, that the shift to higher ground of field theory in morphology is patent. He introduces this theme as early as page 17:

". . . the development of each point [in the mesoderm of an altered embryo] is modified in relation to its position within the total amount which is still left, so again a normal embryo is formed. Such happenings are spoken of as 'field phenomena'. The reference of this name is to physical field theories, such as those of magnetism, gravitation, and so on. The implication is not, of course, that these physical forces are operating, but merely that the biological events have the same general character as the physical ones; in both cases there must be some activity spread throughout the whole region occupied by the field, and distributed in an orderly graded manner, so that in some parts the activity is strong, in others weak, with intermediate strengths between.

"In some ways, field properties are complementary to those involved in ooplasmic segregation. In the latter we are confronted with a small number of differences, usually sharply distinct from one another and each confined to a particular region; in the former with graded differences in some property which spreads throughout the whole of a wide area. From another point of view, the notion of fields is closely connected with that of evocation, since when we say that the development of one point in the field is dependent on its relations with its neighbors, we must imply that those neighbors influence it in a way somewhat similar to that involved in evocation. In fact, one might conclude that ooplasmic segregation and evocation are the processes which occur in those aspects of development which involve sharp and clear-cut differences, such as the formation of different types of tissue, while field phenomena are found when the differences are blurred and integrading as they are between the various parts of a single harmonious organ. This gives one hope that eventually it will be possible to see all three types of mechanism as mere variants of some more general type."

—*F. L. Kunz*

About Life — With Love

THOSE who have read *The Measure of Man,* by Joseph Wood Krutch, remember with pleasure the felicity of expression and the range of thought which this author brings to his writing. Now we have before us *The Great Chain of Life* by the same author (Boston, Houghton Mifflin Company, 1956, 227 pp. $3.75) which is another wonderful experience to read.

As implied by the title, life is viewed in its entire range. The so-called "simple" organisms, originating by whatever means one can conceive, are shown to be anything but simple. The basic forms of life possess complexity, structure and functional stability which are beyond the power of any theory to explain as yet.

One of the most fascinating chapters deals with the dual invention of sex and death by protozoa. Without these, Krutch shows us, no evolution—and nothing that we value in life—could have been possible.

In reading this lovely volume, one is repeatedly aware that Krutch is discussing the same basic problems of organization, goal-seeking, and purpose that concern E. W. Sinnott—and in very similar terms. For example, no one could read his chapters on food-gathering, on parenthood ("With Love and Without"), and on metamorphosis without excitement and a sense of awe. In these manifestations life demonstrates not only its complexity but its insistence and persistence to organize toward some powerfully-operating *teleos.*

Krutch attacks the problem of classifying life into "higher" and "lower" forms, and relates this to the accepted view of evolution that selection is always toward survival values. ". . . by the criteria usually favored by objective scientists, the insects should be called the 'highest' animals—highest from the standpoint of

the biologist because most likely to survive; highest from the standpoint of the anthropologist because culturally most advanced. The bighorn (elk) may be 'noble' but by comparison with the ant he is at most a noble savage. Moreover, while he is disappearing from the earth, the ants are still here in undiminished numbers. . . . Either the 'higher' animals are not really higher, or they are higher because they are capable of something we consider more important than elaborateness of the 'survival value' of the instinctive techniques in which creatures 'lower' than they far surpass them."

The author treats us to an excellent chapter on awareness and discusses the presence of "undeveloped potentialities" in animals—undeveloped in their natural state but capable of development in association with man. This is a sensitive discussion of experiences every pet-lover has in his dealings with "lower" forms of life.

Krutch develops a scathing thesis against killing for "sport." Here is a new and much-needed twist to intelligent "Reverence for Life," a chapter title which the author adopts from Schweitzer.

In further reference to his discussion of evolution as a "chain" which we have long assumed to lead always and inevitably "upwards" toward "progress," Krutch sounds a warning note by citing case histories of those forms of life which have already entered into self-satisfied niches or have begun the dangerous experiment of devolution.

The reviewer could go on and on. However, let him add but on more bit, important for us humans: "Pleasure, which we seek as a compensation for the joy we seldom feel, is both worthless and harder to come by. It requires some positive occasion and adequate occasions become harder and harder to create. Pleasure sickens from what it feeds on, joy comes easier the more often one is joyous. We relapse into melancholy or discontent and boredom. We suffer one or the other if we find at the moment no occasion for a different emotion. But nature, so it seems, relapses into joy. Is any other art more worth learning?"

This last fragment has been torn from the context of Krutch's "Epilogue" which should be required reading even if the balance of the book is not opened.

—Harvey W. Culp

Physics: Data and Concepts

PRINCIPLES *and Applications of Physics,* by Otto Bluh, University of British Columbia, and Joseph D. Elder (of Harvard University Press), is a remarkable new kind of text book. (Interscience Publishers, Inc., New York, 833 pages and index, 1957. Richly illustrated. $7.) It contains thorough expositions and basic mathematics for methods of physics, and then goes through basic concepts (kinematics, mechanics of mass points, of rigid bodies and of matter), forms of energy (heat, electric, radiant), fields of force (gravitational, electrostatic, electromagnetic, electrodynamic), oscillations and waves (mechanical and acoustical, high-frequency and electromagnetic, physical optics) and so on, with a view to establishing the facts and principles required for a modern philosophy of physics. The owner of the book thus has in one volume the fundamental data for the formulation of his concepts.

Nor is he left there. The authors themselves proceed to over one hundred and fifty pages of exposition of the philosophy of physics, physics and the cultural sciences (physics, metaphysics and the humanities), and teaching and research. An historical table and a good index are also supplied.

We realize we have gone far when a superbly competent university text in physics can refer in the index not only to religion and science (pages 808-809), but to religious experience (page 803), as matters which arise from the science itself, and from science generally, calling for new thought because there is new knowledge. How far? This is a matter for personal opinion. The writer of this notice would say: Not yet far enough. We would like to see texts of this kind in all branches of science, and in each ample discussion of the principles formally organized. Resonance (for example) is a process of immense significance. Symmetry (not even listed in this index) is another. The student deserves guidance further along such avenues.

Principles and Applications of Physics is more than a textbook. It is an event in thought. It is so good that one wants more and more of the same kind, philosophically organized science, from authors and publishers.

—Alan Mannion

The East for Everyone

THE tendency to produce valuable and serious works in paper covers continues to gain strength. Currently books are appearing, and being advertised simultaneously, in both cloth-board and paper covers, a remarkable fact. In the case of *The Nature of the Non-Western World,* by Vera Micheles Dean, the publishers (New American Library, New York) have brought it out in their Mentor series at 50¢, as a first appearance. It can be warmly recommended to the great public which this form is intended to reach.

Dr. Dean has long been editor of *Foreign Policy Bulletin,* and as such writes with that impartiality which is needed as the corrective to the excesses of nationalism, the fever which confuses policy as much today as ever it did. Perhaps its evils have been increased. All the more reason for books like this.

The author starts with the Bandung Conference and the accelerated pace of history, "many centuries in one"; and then opens with Russia, as the leading power in the non-Western world. India and China come next, and so through the review, to Africa and South America. She notes many aspects of the economic problems, and this gives the book special value; but it is too much to hope that in a work of this kind today the economic aspect will be traced back to the very root. Dr. Dean would put us all under debt if she were to tackle this issue on some future occasion. The public needs to know and is entitled to know precisely how four countries, Great Britain, Russia, U. S. A., and India, tie economic practice into political policy and propaganda. This might be the most enlightening book of our time, if ever it were to be done. Meantime *The Nature of the Non-Western World* is a very real help.

—F. L. Kunz